Conklin Company Inc.
TECHNICAL BULLETIN
B-01-05-4
Metal Building Thermal Bridging and Condensation

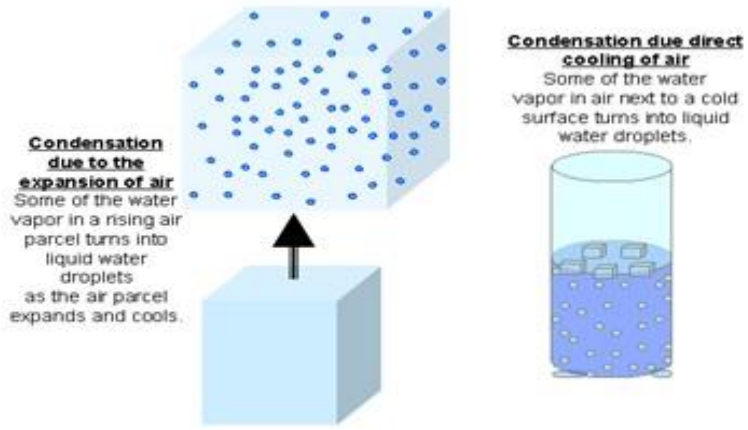
Considerations When Coating A Metal Roof

Metal pole barn style buildings that have loose laid fiberglass insulation, metal walls and a metal roof are conducive to interior condensation for many different reasons. Thermal bridging or conductivity is one of the most common reasons for this issue. Heating, cooling, ventilation, humidity and climate zone are some of the other contributors to this situation. When all these factors are considered before applying a highly reflective coating to a roof like this, the risk of causing condensation problems is considerably lessened.

Condensation

1) Water that collects as droplets on a cold surface when humid air is in contact with it. (*synonyms:* moisture, water droplets, steam) “windows misty with condensation”
2) The conversion of a vapor or gas to a liquid. (*synonyms:* precipitation, liquefaction, deliquescence.) “the condensation of the vapor” (See figure #1)

Figure #1



Thermal Conductivity (bridging)

A **thermal bridge**, also called a cold **bridge** or heat **bridge**, is an area or component of an object which has higher **thermal** conductivity than the surrounding materials, creating a path of least resistance for heat transfer. **Thermal** bridges result in an overall reduction in **thermal** resistance of the object. (See figure #2 - #4)

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FIgure #2

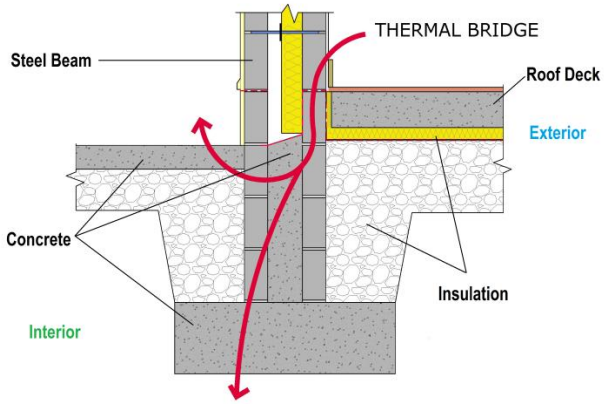


FIgure #3

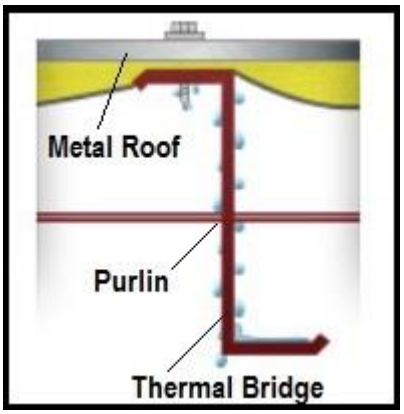
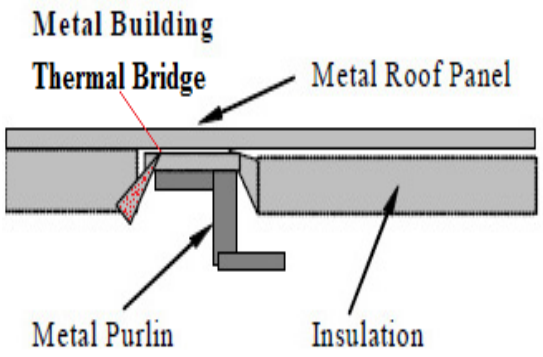
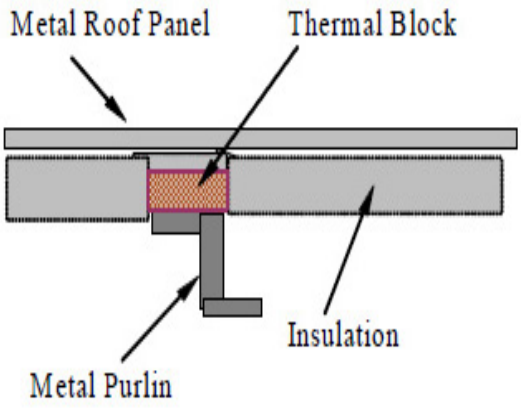


FIgure #4





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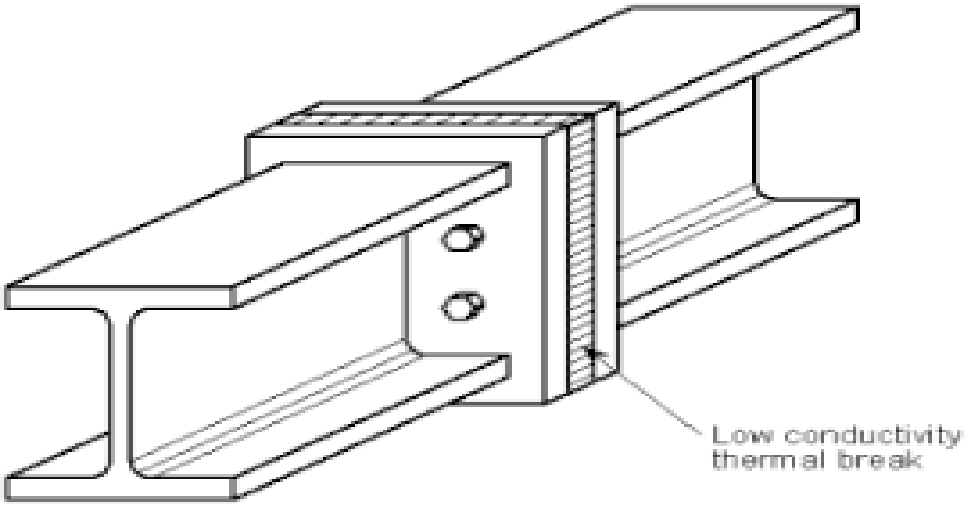
Thermal Break (barrier)

A **thermal break** or **thermal** barrier is an element of low **thermal** conductivity placed in an assembly to reduce or prevent the flow of **thermal** energy between conductive materials. (See figure #5)

FIgure #5



Components of a Metal Building

Each component of a metal building can contribute to thermal conduction and interior ambient temperature changes as well as temperature changes on the exterior of the building. One example of this phenomenon is when the roof panels are unpainted steel and they are coated with a highly reflective roof coating, in many cases this can cause a condensation issue through thermal conductivity. The dark panels will have more solar gain than a white coated panel and that means once coated, these panels will have a lower temperature. Depending on the interior temperature, humidity level, type of insulation and the climate zone, once a dark roof is converted to a light highly reflective roof, the thermal conductivity will change and condensation may be an issue.
(See figure #6)

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FIgure #6

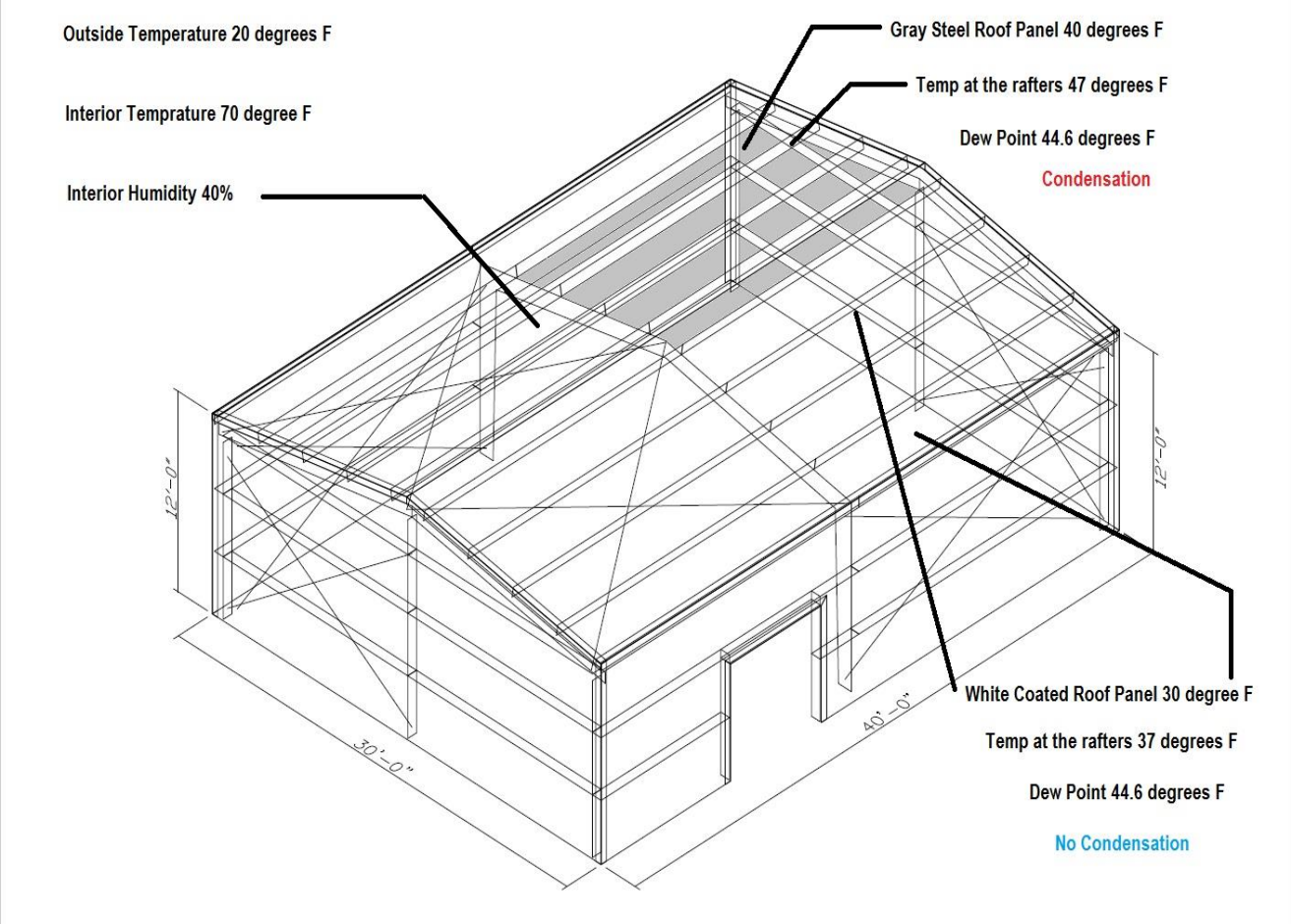

Figure #6 shows a scenario where the building is heated, the insulation is lose or missing in one area which allows the warm heated air to contact the colder thermal bridge (rafter and roof panel) and cause a condensation situation.

Thermal Bridge Factors

Loose, torn or missing insulation is one of the most common causes for thermal bridging. Another reason for this issue comes from the original design of the building. (See figure #7)

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FIgure #7

Dew Point

The dew point in this example is in constant change and depends on three factors. These factors are outside temperature, inside temperature and inside humidity. (See table #3) The various thermal bridges or conductors in this building envelope help define where the dew point will be at any given time.

Table 3: Dew point Based on Varying Temperature

Inside Temperature	Inside Humidity	Dew point	Outside Temperature	Condensation
70˚ F	20%	27˚ F	20˚ F	Yes
70˚ F	20%	27˚ F	30˚ F	No
70˚ F	30%	37˚ F	30˚ F	Yes
70˚ F	40%	44.6˚ F	40˚ F	Yes
Dew point calculations show that condensation can easily form inside a poorly insulated metal building with interior humidity as low as 20%.				

No Simple Answers

The simple answer to the question of condensation is not simple, yet it can be answered through testing and measuring the temperature and humidity of the interior environment. An engineer or building envelope specialist should always be consulted when dealing with these situations.